

**REMARKS**

**I. STATUS OF THE CLAIMS**

Claims 1, 3, 4, 7-16, 19, 20, 22, 23, 26, and 32-37 are pending in the present application. Claims 1, 12, 19 and 33 are the independent claims.

Claims 1, 9, 10, 12, 14, 15, 19 and 33 have been amended and claims 36 and 37 have been added. New claims 36 and 37 were written in order to correct the minor errors of original claims 10 and 15. No new matter is believed to have been added.

Claims 6 and 25 have been cancelled without prejudice or disclaimer of the subject matter recited therein.

**II. THE REJECTION OF CLAIMS 1, 3, 4, 6-11, 14, 15, 19, 20, 22, 23, 25, 26 AND 32-35 UNDER 35 U.S.C. §112, SECOND PARAGRAPH, AS BEING INDEFINITE FOR FAILING TO PARTICULARLY POINT OUT AND DISTINCTLY CLAIM THE SUBJECT MATTER WHICH APPLICANT REGARDS AS THE INVENTION**

Claims 6 and 25 have been cancelled without prejudice or disclaimer of the subject matter recited therein. Accordingly, the rejection of claims 6 and 25 is moot.

Applicants have amended claims 1, 9, 10, 14, 15, 19 and 33 and have added claims 36 and 37 to correct the minor errors noted by the Examiner.

Accordingly, Applicants respectfully request that the rejection of claims 1, 9, 10, 14, 15, 19 and 33 under 35 U.S.C. § 112, second paragraph be withdrawn.

Furthermore, Applicants respectfully request that the rejection of claims 3, 4, 7-8, 11, 20, 22, 23, 26, 32 and 34-35 be withdrawn since these claims depend from claims 1, 19 and 33.

**III. THE REJECTION OF CLAIMS 1, 3, 4, 6-11, 19, 20, 22, 23, 25, 26 AND 33 UNDER 35 U.S.C. §102(b) AS BEING ANTICIPATED BY VOURLIS (US 5,432,030)**

Applicants respectfully traverse this rejection for at least the following reasons.

Claims 6 and 25 have been cancelled without prejudice or disclaimer of the subject matter recited therein. Accordingly, the rejection of claims 6 and 25 is moot.

Independent claim 1 recites a lithium-sulfur battery comprising, amongst other novel features, a strong polar solvent comprising one solvent selected from the group consisting of

hexamethyl phosphoric triamide,  $\gamma$ -butyrolactone, acetonitrile, ethylene carbonate, propylene carbonate, N-methyl pyrrolidone, dimethyl formamide, sulfolane, dimethyl acetamide, dimethyl sulfoxide, dimethyl sulfate, ethylene glycol diacetate, dimethyl sulfite, and ethylene glycol sulfite.

Independent claim 19 recites an electrolyte for use in a lithium sulfur battery comprising, amongst other novel features, a strong polar solvent comprising one solvent selected from the group consisting of hexamethyl phosphoric triamide,  $\gamma$ -butyrolactone, acetonitrile, ethylene carbonate, propylene carbonate, N-methyl pyrrolidone, dimethyl formamide, sulfolane, dimethyl acetamide, dimethyl sulfoxide, dimethyl sulfate, ethylene glycol diacetate, dimethyl sulfite, and ethylene glycol sulfite.

Independent claim 33 recites a method of manufacturing a lithium-sulfur battery, comprising, amongst other novel features, a strong polar solvent selected from the group consisting of hexamethyl phosphoric triamide,  $\gamma$ -butyrolactone, acetonitrile, ethylene carbonate, propylene carbonate, N-methyl pyrrolidone, dimethyl formamide, sulfolane, dimethyl acetamide, dimethyl sulfoxide, dimethyl sulfate, ethylene glycol diacetate, dimethyl sulfite, and ethylene glycol sulfite.

Vourlis teaches an electrochemical cell comprising a pure lithium or lithium alloy anode, an Fe/S<sub>2</sub> cathode and an electrolyte comprising a solvent mixture of 1,3-dioxolane, 1,2 dimethoxyethane and **3-methyl-2-oxazolidone** with at least one solute selected from the group consisting of LiI and LiCF<sub>3</sub>SO<sub>3</sub> (column 2, lines 57-62).

Vourlis fails to teach or suggest that the strong polar solvent is selected from the group consisting of hexamethyl phosphoric triamide,  $\gamma$ -butyrolactone, acetonitrile, ethylene carbonate, propylene carbonate, N-methyl pyrrolidone, dimethyl formamide, sulfolane, dimethyl acetamide, dimethyl sulfoxide, dimethyl sulfate, ethylene glycol diacetate, dimethyl sulfite, and ethylene glycol sulfite.

Furthermore, independent claim 1 recites a positive electrode including a positive active material comprising at least one sulfur-based compound selected from the group consisting of elemental sulfur and organosulfur compounds.

Vourlis only discloses a FeS<sub>2</sub> positive active material.

Accordingly, Applicants respectfully assert that the rejection of claims 1, 19 and 33 under 35 U.S.C. § 102(b) should be withdrawn because Vourlis fails to teach or suggest each feature of independent claims 1, 19 and 33, as amended.

Furthermore, Applicants respectfully assert that dependent claims 3, 4, 7-11, 20, 22, 23 and 26 are allowable at least because of their dependence from claims 1, 19 and 33 and because they include additional features which are not taught or suggested by the prior art. Therefore, it is respectfully submitted that claims 3, 4, 7-11, 20, 22, 23 and 26 also distinguish over the prior art.

**IV. THE REJECTION OF CLAIMS 1, 3, 4, 6-16, 19, 20, 22, 23, 25, 26, 32 AND 33 UNDER 35 U.S.C. §102(B) AS BEING ANTICIPATED BY EVANS (US 4,302,520)**

Applicants respectfully traverse this rejection for at least the following reasons.

Claims 6 and 25 have been cancelled without prejudice or disclaimer of the subject matter recited therein. Accordingly, the rejection of claims 6 and 25 is moot.

Independent claim 1 recites a lithium-sulfur battery comprising, amongst other novel features, a strong polar solvent comprising one solvent selected from the group consisting of hexamethyl phosphoric triamide,  $\gamma$ -butyrolactone, acetonitrile, ethylene carbonate, propylene carbonate, N-methyl pyrrolidone, dimethyl formamide, sulfolane, dimethyl acetamide, dimethyl sulfoxide, dimethyl sulfate, ethylene glycol diacetate, dimethyl sulfite, and ethylene glycol sulfite.

Independent claim 12 recites a lithium sulfur battery comprising, amongst other novel features, a strong polar solvent is selected from the strong polar solvent group consisting of hexamethyl phosphoric triamide,  $\gamma$ -butyrolactone, acetonitrile, ethylene carbonate, propylene carbonate, N-methyl pyrrolidone, sulfolane, dimethyl sulfate, ethylene glycol diacetate, dimethyl sulfite, and ethylene glycol sulfite.

Independent claim 19 recites an electrolyte for use in a lithium sulfur battery comprising, amongst other novel features, a strong polar solvent comprising one solvent selected from the group consisting of hexamethyl phosphoric triamide,  $\gamma$ -butyrolactone, acetonitrile, ethylene carbonate, propylene carbonate, N-methyl pyrrolidone, dimethyl formamide, sulfolane, dimethyl acetamide, dimethyl sulfoxide, dimethyl sulfate, ethylene glycol diacetate, dimethyl sulfite, and ethylene glycol sulfite.

Independent claim 33 recites a method of manufacturing a lithium-sulfur battery, comprising, amongst other novel features, a strong polar solvent selected from the group consisting of hexamethyl phosphoric triamide,  $\gamma$ -butyrolactone, acetonitrile, ethylene carbonate, propylene carbonate, N-methyl pyrrolidone, dimethyl formamide, sulfolane, dimethyl acetamide, dimethyl sulfoxide, dimethyl sulfate, ethylene glycol diacetate, dimethyl sulfite, and ethylene

glycol sulfite.

Evans discloses a non-aqueous cell utilizing an active metal anode, a cathode and a liquid organic electrolyte such as **3-methyl-2-oxazolidone** in conjunction with a solvent and a selected solute (column 1, lines 7-14). The solvents used by Evans include tetrahydrofuran, methyl-substituted tetrahydrofuran, 1,3 dioxolane; **3-methyl-2-oxazolidone**; propylene carbonate and others (column 4, lines 28-35).

Furthermore, Evans discloses a solid cathode material such as  $\text{Bi}_2\text{Fe}_2\text{S}_5$  and  $\text{Bi}_2\text{Pb}_2\text{S}_5$  which is different from the sulfur-based compound selected from the group consisting of elemental sulfur and organosulfur compounds, as recited in independent claim 1.

Therefore, although Evans discloses strong and weak solvents, Evans fails to teach or suggest a strong polar solvent selected from the strong polar solvent group consisting of hexamethyl phosphoric triamide,  $\gamma$ -butyrolactone, acetonitrile, ethylene carbonate, propylene carbonate, N-methyl pyrrolidone, sulfolane, dimethyl sulfate, ethylene glycol diacetate, dimethyl sulfite, and ethylene glycol sulfite, as recited in independent claims 1, 12, 19 and 33.

Accordingly, Applicants respectfully assert that the rejection of claims 1, 12, 19 and 33 under 35 U.S.C. § 102(b) should be withdrawn because Evans fails to teach or suggest each feature of independent claims 1, 12, 19 and 33, as amended.

Furthermore, Applicants respectfully assert that dependent claims 3, 4, 7-11, 13-16, 20, 22, 23, 26, and 32 are allowable at least because of their dependence from claims 1, 19 and 33 and because they include additional features which are not taught or suggested by the prior art. Therefore, it is respectfully submitted that claims 3, 4, 7-11, 13-16, 20, 22, 23, 26, and 32 also distinguish over the prior art.

V. THE REJECTION OF CLAIMS 10, 15, 34 AND 35 UNDER 35 U.S.C. §103(a) AS BEING UNPATENTABLE OVER VOURLIS (US 5,432,030) OR EVANS ET AL. (US 4,302,520), IN VIEW OF KATZ ET AL. (US 6,358,643)

Applicants respectfully traverse this rejection for at least the following reasons.

Claims 10, 15, 34 and 35 depend from independent claims 1, 12 and 33.

As noted above, neither Vourlis nor Evans whether taken singly or combined teach or suggest the features of independent claims 1, 12 and 33.

Katz discloses a lithium-sulfur battery which includes a negative electrode, a positive

electrode and a liquid catholyte including a solvent (abstract). Katz also teaches that the electrolyte may include a co-solvent such as dioxolane (column 3, lines 52-53).

Therefore, although Katz discloses a lithium-sulfur battery comprising a negative electrode, a positive electrode and dioxolane, Katz fails to teach or suggest a strong polar solvent is selected from the strong polar solvent group consisting of hexamethyl phosphoric triamide,  $\gamma$ -butyrolactone, acetonitrile, ethylene carbonate, propylene carbonate, N-methyl pyrrolidone, sulfolane, dimethyl sulfate, ethylene glycol diacetate, dimethyl sulfite, and ethylene glycol sulfite, as recited in amended claims 1, 12 and 33.

Accordingly, Katz fails to cure the deficiencies of Vourlis and Evans.

Therefore, Applicants respectfully assert that the rejection of claims 10, 15, 34 and 35 under 35 U.S.C. §103(a) should be withdrawn because neither Vourlis, Evans nor Katz, whether taken singly or combined teach or suggest each feature of independent claims 1, 12 and 33 upon which claims 10, 15, 34 and 35 depend.

Furthermore, Applicants respectfully assert that dependent claims 10, 15, 34 and 35 are allowable because they include additional features which are not taught or suggested by the prior art. Therefore, it is respectfully submitted that claims 10, 15, 34 and 35 also distinguish over the prior art.

## VI. CONCLUSION

In accordance with the foregoing, it is respectfully submitted that all outstanding rejections have been overcome and/or rendered moot. And further, that all pending claims patentably distinguish over the prior art. Thus, there being no further outstanding rejections, the application is submitted as being in condition for allowance which action is earnestly solicited.

If the Examiner has any remaining issues to be addressed, it is believed that prosecution can be expedited and possibly concluded by the Examiner contacting the undersigned attorney for a telephone interview to discuss any such remaining issues.

If there are any underpayments or overpayments of fees associated with the filing of this Amendment, please charge and/or credit the same to our Deposit Account No. 503333.

Respectfully submitted,

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